‘Study of the issues involved in the flow of material and information in varying demand and supply conditions for the lean manufacturing’

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SYNOPSIS

1. Abstract

Lean concept has first come into existence in the Japanese manufacturing industries. It is a philosophy which mainly focuses on the elimination of waste. Elimination of waste ultimately makes the industries efficient and profit making. It is cluster of tools and techniques to identify and eliminate waste. In fact, every industry undergoes huge processes. Every process has some or the other waste. But most of the times the identification of the waste itself is very critical and huge task because of the number of people involved in it. People work in an organization with different skill sets, methods, philosophies and normally do not share their views about the processes. Toyota Production System first implemented the Lean in their Plant in Japan. It was also called as TPS. Elimination of every waste was their motto. They defined it in three broad categories i.e. muda, muri and mura. All the three are Japanese words. Muda means waste, muri means unreasonable work and mura means finding the ways to eliminate the fluctuations in the process for better quality and volume. Every process in an industry is not Value Adding. Some of them are Non value Adding activities. Muri focuses on the preparation and planning of the process so that unnecessary work can be avoided proactively by design. Mura focuses on the implementation of muri i.e. process design implementation to elimination the fluctuations in operations. *Muda* can be identified through out the processes and thus can be eliminated.

The original seven *muda* identified by Japanese are as below

1. Unnecessary or over transportation.
2. Over inventory at different stages in the industry.
3. Unnecessary motion of people and equipments, moving or walking more than the requirement.
4. Waiting for next operation, information, decision etc.
5. Overproduction

6. Over Processing
7. Generation of defective products or services.

Different set of tools are used to eliminate muda i.e. waste. Examples of such tools are JIT – Just in Time, Poka yoke i.e. mistake proofing, VSM – Value Stream Mapping, Kanban – Pull system, Five S etc.

Lean manufacturing is based on optimizing flow; increasing efficiency, decreasing waste, and using empirical methods to decide what affects. Also known as the flexible mass production, the Toyota Production System (TPS) has two pillar concepts: Just in time (JIT) or 'flow', and 'automation'. It believes that, if production flows uniformly without any stoppages and rejections then the inventory at each stage of the production shall be minimum. And if quality products are produced at lower costs and delivered in the committed time to the customer, the effort is spent only on the features that customer values. Just in time (JIT) frequently relies on the use of physical inventory cues (Kanban) to signal the need to move materials. This is called 'pull' type of production which is highly responsive to the customers.

As this concept continues to spread in India through the multinational manufacturing giants in the sector, the research on the topic is extremely essential to help the industries and researchers.

2. Introduction

Manufacturing quality products at lower costs and delivering it to the customers within prescribed timeframe is a global need to be competitive. It can be achieved through implementing Lean practices and eliminating the waste within the processes. Lean manufacturing is also known simply as 'Lean'. It is a practice which considers the utilization of resources for the end product or services than the creation of value for the end customer to be wasteful. It aims at identification and elimination of all waste in the processes or systems by involving all concerned. Value may be defined as any set of actions or processes that a customer would be willing to pay for. That's why lean is aimed at creating more

and more value for the customers with less and less work. Lean management is a generic process management philosophy derived mostly from the Toyota Production System (TPS). It is focused on reduction of the original Toyota seven wastes in order to improve overall customer value, but there are varying perspectives on how this is best achieved. The steady growth of Toyota, from a small company to the world's largest automaker is the best example of lean manufacturing i.e. identification and elimination of waste in the manufacturing system and create value for the customers. Huge cost is normally blocked in inventories. Reduction in the inventories largely helps the organizations to maintain flow and reduce the cost of manufacturing. Kanban systems prevent the inventories to increase beyond the designed limits. Just in time integrated with kanban systems can yield better results to reduce inventories. But many times the demands are not the same. Manufacturing activities need to be planned as per the demand from the market i.e. customer. Similarly, there can be interruptions in the supplies. Variations in the demand and supply adversely affect the inventory management. It adds non value adding costs in the value chain and thus increases the manufacturing costs.

3. Problem

Manufacturing quality products at lower costs and to deliver in the prescribed timeframe to the customers is a challenge in the present competitive global scenario. Manufacturing costs needs to be lowered to sustain the competition. Lean manufacturing aims at reducing the manufacturing cost by elimination of waste in the value chain. Excess inventory in the system is one of the major waste. Inventory can be reduced by implementing kanban system and its integration with just in time (JIT). But demand from the market or customer is normally not constant, it varies. Similarly the supply to suit the demand needs to be planned and executed. Variation in the supply can adversely affect the inventory management. Issues involved in the flow of material and information in varying

demand and supply conditions for the lean manufacturing needs to be studied to address such situations in manufacturing industries.

4. Literature Review

Various literature available indicates that traditional kanban system has helped the manufacturing industries to reduce the in process inventory in normal demand situations. Integration of Just in Time (JIT) with flexible kanban system considering the varying supply and demand conditions is very essential to be lean. Following is the list of relevant literature review done to study the subject in details and to arrive at the gaps.

a) Houmin Yan, *'The optimal number of kanbans in a manufacturing system with general machine breakdowns and stochastic demands'* (1995), - efforts are made to find the optimal number of circulating kanbans for a manufacturing system with general machine breakdown and stochastic demand.
b) Yannick Frein, Maria Di Mascolo and Yves Dallery, *'On the design of generalized kanban control systems'*, (1995) investigated the influence of design parameters on the efficiency of generalized kanban control policies, some results that can be useful for designing multistage Generalized Kanban Control Systems (GKCS), Further work should focus on the optimal design of GKCS
c) D. J. Stockton and R.J. Lindley, *'Implementing kanbans within high variety/low volume manufacturing environments',* (1995) , developed methods for identifying Group Technology (GT) cells since these flow lines create the conditions for successful JIT manufacture. Material flows would be simplified, process orientated and controlled using kanbans.
d) Andijani, *'Trade-off between maximizing throughput rate and minimizing system time in kanban systems* (1997), - it deals with development of a general design rule for allocating kanbans with two objectives

e) *Surendra M. Gupta, Yousef A.Y. Al-Turki and Ronald F. Perry, 'Flexible kanban system', (1999) - it introduced a systematic methodology to manipulate the number of kanbans in a JIT system, Simulation was used to study the performances of the Traditional Kanban System (TKS) and Flexible Kanban System (FKS) in various operating environments. FKS outperforms the TKS when different types of variations are considered*

f) Andrew Lee Mortimer, *'A continuing lean journey: an electronic manufacturer's adopting of Kanban'* (2008) - it explains in detail the working and benefits gained from the changes introduced, observing some of the finer details of the electronic Kanban system, the paper looks at the interesting planned steps in the system's "evolution".

g) Antonio C. Caputo and Pacifico M. Pelagagge, *'A methodology for selecting assembly systems feeding policy* (2011) - it allows trade-offs between alternatives to be explored in order to deploy customized feeding policies differentiated on components basis to better fit specific company requirements.

h) Michael S. Spencer, Dale S. Rogers and Patricia J. Daugherty, *'JIT Systems and External Logistics Suppliers'* (1994) - question emerges when the logistics functions are viewed from a systems-wide perspective. What aspects of JIT are applicable to the entire logistics system, there appear to be significant opportunities for manufacturers with JIT systems to develop supplier-partners with logistics service providers.

i) Jean-Noel Ezingeard and Peter Race, *'Spreadsheet simulation to aid capacity management of batch chemical processing using JIT pull control',* (1995) development of a spreadsheet tool to assist planners for the capacity management approaches. The model also enabled management's attention to focus on the tradeoff between the cost of holding stock versus the cost of incurring increased levels of process scrap and resources downtime.

j) Jan Olhager, *'Technical note Safety mechanisms in just-in-time systems'* (1995), stated that the three basic approaches to provide safety are implicitly included in a kanban system by means of the safety factor.

k) Loknath Sriparavastu and Tarun Gupta,*'An empirical study of just-in-time and total quality management principles implementation in manufacturing firms in the USA' (1997)* - the study involved kanban, and group technology principles, which are very important for a successful implementation of JIT.

l) Katsuhiko Takahashi, Nobuto Nakamura and Masanobu Izumi, *'Concurrent ordering in JIT production systems',* (1997) - it was clarified that the degree of the influence of changing the ordering systems from the kanban system to the concurrent ordering system on the average WIP inventory differs between the final stage and the others.

m) Katsuhiko Takahashi and Nobuto Nakamura, *'Agile control in JIT ordering systems'* (2000) - the performances of the two proposed systems were analyzed and compared with each other, the revised system is effective to react to unstable changes in demand, and agile control in the JIT ordering systems for multi-stage production inventory systems

n) Roongrat Seeluangsawat and Erik L.J. Bohez, *'Integration of JIT flexible manufacturing, assembly and disassembly system using Petri net approach',* (2004) paper presents a new generic Petri net (PN) model for design and performance evaluation of a flexible assembly system (FAS) and disassembly system (DAS) with dual kanban. Current research focuses on developing a suitable algorithm to find the invariants.

o) Jack E. Matson and Jessica O. Matson,*'Just-in-time implementation issues among automotive suppliers in the southern USA',* (2007), This paper provided a concise review of JIT literature. These smaller, primarily non-union automotive suppliers represented a research set that has not been previously studied, findings of this study can help others considering a conversion to a JIT system improve the likelihood of a successful implementation

p) Hamid Ullah and Erik L.J. Bohez, *'A Petri net model for sequence optimization and performance analysis of flexible assembly systems'* (2008) - a new generic Petri net (PN) model based on assembly plan for assembly sequence optimization was presented. The assembly manager may design,

analyze, evaluate, and even optimize the layout of the FAS for minimum WIP, maximum throughput, and reduced lead time by using the PN model.

q) Pamela J. Zelbst, Kenneth W. Green, Jr Roger D. Abshire and Victor E. Sower, *'Relationships among market orientation, JIT, TQM, and agility'*, (2010) - Manufacturers must be focused on their customers changing needs, provide relatively low cost products and services, provide relatively high quality products and services, and be able to respond rapidly to changes in customer demand.

5. Research Objective

Objective of the research is to study the issues involved in the flow of material and information in varying demand and supply conditions for the lean manufacturing. It shall address the issues related to generic kanban, flexible kanban system and integration with just in time (JIT) philosophy and practices. It shall also address the various issues involved in the situations in which the demand from the market i.e. customers vary as well as there are interruptions / variations in the supply.

6. Proposed Methodology

It is proposed to conduct a survey in the manufacturing industries to figure out the scope of the work. An exploratory literature review shall be done to study the issues in details and to identify the gaps based on the literature review and the requirement of the industries. Development of a methodology to integrate Kanban and JIT is proposed which intends to further develop a methodology to integrate in bound and outbound logistics and lean related issues also. Extension of this methodology shall be done to study the issues involved in the flow of material and information in varying demand and supply conditions for the lean atmosphere. Objectives of studying the issues involved in the flow of material and information

in varying demand and supply conditions in Indian scenario shall be fulfilled by undertaking an exploratory research.
Quantitative models shall be used or developed to probe into the issues involved.

7. Issues to be Addressed

This research shall address following issues related to manufacturing industries

- Variation in demand and supply
- Issues involved in flow of material
- Issues involved in flow of information
- Inbound and outbound logistics
- Use of kanban system
- Integration of kanban with just in time (JIT)

8. Conclusion

Manufacturing of quality products at lower costs and to deliver within prescribed timeframe as per demand of the customer is the key issue in the competitive world today. Manufacturing processes need inventories at different stages to process materials. Excess inventory leads to non value adding cost and thus affects the manufacturing cost adversely. Variations in the demand and supply of material and information impacts the inventory and thereby manufacturing cost. The study of the issues involved in the flow of material and information in varying demand and supply conditions for the lean manufacturing shall benefit the industries and academicians up to a great extent.

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